APPENDIX C
1999 MARINE BIOLOGICAL SURVEY

Seacliff Pier Caissons Post Demolition
Marine Biological Survey

SEPTEMBER 1999

Prepared for

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Supplement Video "Marine Biology and Habitat Survey, Demolished Caissons at Seacliff Piers". September 1999, 25 minutes.

Introduction

The Seacliff Pier Complex (Seacliff) originally comprised a series of pile-supported oil and gas production piers that extended from the shoreline south and west from the Seacliff area of Ventura County (see Figure 1). From December 1997 through September 1998 the four piers, five attached wharves, and four concrete caissons were removed. Removal of the caissons necessitated the use of explosives. Padre Associates, Inc. (1999) reports the results of a debris survey that comprised a bathymetric and sidescan sonar survey of 6.8 million ft^2 of seafloor in water depths of from 8 to 38 feet at and around the Seacliff area. The imagery collected by the sidescan sonar revealed a series of "targets", including the remnants of the four concrete caisson structures on the seafloor. In June 1999, divers located and removed the steel debris depicted in the sidescan records. Divers also completed limited videodocumentation of the condition of and biota associated with the caisson concrete rubble.

Following a review of Padre, Inc. (1999), the California State Lands Commission requested the Seacliff owners/operators, Mobil Exploration Production, Inc. and the Rincon Island Limited Partnership, to complete a more detailed survey of the marine habitats and biota associated with the rubble remains of the concrete caissons. L.A. de Wit, Consultant was retained by Padre Associates to complete that survey that was designed to provide the Commission with additional information on the biota on and around the concrete rubble and to compare the epibiota there with the biota attached to adjacent natural rock habitats nearby.

Previous Relevant Studies

In July 1998, prior to the use of barges for removal of Seacliff structures, a marine biological survey was conducted within 16 barge anchor corridors (L.A. de Wit, Consultant, 1998). That survey comprised a team of diver-biologists recording habitat types and macroepibiota within a 54,900 ft^2 area around the existing piers in water depths ranging from 17 to 30 feet (MLLW) and within an existing kelp bed approximately 500 feet northwest of the end of Whitten Wharf.

The habitats during that survey ranged from silty-clay sediments to high- (3.0 to 10.0 feet high) relief rocks. However, most of the seafloor inshore and offshore of the piers was either sediment (sand inshore and silts offshore), or mixed sediment and low- (1.5 feet high) to medium- (1.5 to 3.0 feet high) relief boulders. Shale ridges 0.3 to 1.0 feet high were common inshore (south) of the pier, and two high-relief rock areas were observed southeast of Ferguson Wharf and northeast of Whitten Wharf. These features supported sea fans and the colonial anemone *Corynactis californica.*

The biota associated with the low-relief solid substrate was relatively depauperate (de Wit, personal observation) dominated by leafy red algae and hydroids and the sand castle worm, *Phragmatopoma californica*, L.A. de Wit, Consultant (1998). Higher relief features supported sea fans, *Muricea* sp. solitary tunicates, urchins, and sea stars, none of which were considered abundant. That report also states that most of macroepibiota was attached to the upper portions of the rocky substrate, above the :"scour line". No kelp was observed attached to the rocky substrate around the piers.

The kelp bed macroepibiota was characterized as "…relatively poorly developed compared to other Santa Barbara Channel kelp beds" possibly due to storm wave activity over the previous winter and heavy sediment deposition on the rocks. The health of the kelp plants was considered "marginal" with ectoprocts growing on "most fronds" (L.A. de Wit, Consultant, 1998).

Personnel, Methods, and Equipment

The field data collection effort was completed on 8-9 September 1999 by Mr. Ray de Wit of L.A. de Wit, Consultant and Mr. Rick Ware of Coastal Resources Management. The M.V. *Solera*, a 30-ft. vessel owned by Howorth and Associates, Santa Barbara, California, was used as a dive-support boat. Mr. Peter Howorth operated the boat during the dive survey, and SCUBA was used for all dives.

Fugro West provided locations of the four caissons (see Table 1); in the field, each was located by the onboard GPS system and fathometer. In order to compare the caisson-associated biota with that found on natural rock, two "control" sites were selected. Those sites comprised low-relief ridges and a high-relief rock reef that were proximal to and in similar water depths as the caissons. The low-relief control site was selected from previous dive locations associated with the pre-deconstruction anchor plan survey. The high-relief control site was within a kelp bed founded on natural rock ridges west of the end of Whitten Wharf. That feature was surveyed previously during the pre-construction anchor survey (L.A. de Wit, Consultant, 1998) and was relocated during this survey by the relatively abundant surficial kelp.

Table 1
Locations of Survey Sites

Site	Latitude	Longitude	Depth (Ft., MLLW)[1]
Whitten West	34° 21.010'	119° 26.055'	24 to 19
Whitten East	34° 21.010'	119°26.025'	24 to 20
Needham	34°20.590'	119°25.380'	24 to 22
Ferguson	34°21.005	119°25.505'	21 to 20

[1] As recorded from diver's depth gauges.

The high-relief control site was approximately 500 feet west-northwest and the low-relief control is located approximately 200 feet west of Whitten "West" (the western-most caisson on Whitten Wharf). Descriptions of the habitat and biota of each site are provided below, and the original configuration of the Seacliff piers and wharves and the caisson survey sites are shown in Figure 1.

Utilizing the onboard navigation and bathymetric systems, each dive site was located and a small buoy was deployed. The diver-biologists entered the water and confirmed the presence of the expected habitat. The team then swam north-south and east-west transects over the target, recording abundance of macroepibiota, water depth on underwater slates. After completing those transects, the diver-biologists swam around the base of each target recording observations within the ecotone habitat (interface between the rubble and natural sedimentary/rock bottom). Videodocumentation and still photographs were taken along each transect.

Results and Discussion

Weather throughout the survey was partly cloudy to clear; winds were light in the a.m. hours, increasing to 10 to 15 miles per hour from the west in the afternoon. Water temperature at the seafloor was approximately 60°F; no distinct thermocline was found at any of the sites. A long-period 2 to 3-ft. southwesterly swell prevailed throughout the survey period. Underwater visibility ranged from two to 10 feet with clearest water conditions at the Needham and Ferguson caisson sites.

Collected data comprised diver-biologists' observations, video, and still photographs within the various habitats at and immediately around each site. Sixteen dives, totaling 4.4 hours, were completed at the six sites. Approximately 60 minutes of video and 65 underwater slides were taken.

In addition to this report, a 25-minute edited version of the videotape was produced; a log of that edited video and examples of the photographs are provided at the end of this report. Turbid water conditions precluded wide-angle photographs, however Plates 1-4 provide examples of the habitats and dominant biota at the sites. A more complete overview of the survey sites is provided in the video tape which has been submitted as an attachment to this report.

Habitat Characterization

As described in L.A. de Wit, Consultant, 1998 and shown in Padre Associates, 1999, the natural seafloor habitats around the Seacliff piers comprises a mixture of sediment (sand, silts, and clays) and low-relief solid substrate consisting of sediment-covered boulders and shale bedrock ridges. A seafloor features map in Padre Associates, 1999 indicates most of rock substrate is low-relief (1 to 2 feet high) much of which is located inshore and north of Needham and Whitten piers. Isolated higher-relief rock features were identified near the Needham Wharf by Padre Associates, 1999.

The focus of this study was to characterize the biota associated with remnant concrete from the demolished caissons and on natural rock substrates within the same water depths and in the immediate area of the caisson rubble. The following discusses the habitats observed at each site in the order that they area shown on the aforementioned edited video. Biota associated with each survey site is described later in the report.

Natural Low-Relief. This habitat is characterized by sediment-covered boulders and isolated rock ridges rising up to two feet above the seafloor. The solid substrate is relatively discontinuous with sedimentary areas between the rock. No cobble- or pebble-size rocks were observed in this habitat and water depths ranged from 23 to 24 feet, MLLW.

Natural High-Relief: Rising as much as six feet above the surrounding sedimentary seafloor, the habitat at the high-relief site is characterized by ridges separated by sediment-and cobble-filled depressions. Isolated sediment-covered boulders up to four feet in diameter are present around the base of the feature.

Demolished Caisson Sites: The caisson rubble was surrounded by silty-sand sediments and isolated low-relief boulders and ridges, the caisson sites comprised one inch- to three feet-diameter concrete pieces. The apices of the rubble mounds were one to seven feet above the surrounding sedimentary bottom, with the highest mound (Whitten West) approximately the same height of the nearby natural rock features and about the same height as the natural high-relief reef. The majority of rubble at all four caisson sites was from one to 12 inches in diameter and appeared to be in layers over the natural bottom of mixed sediment, rock, and underlying caisson-associated material. Smaller pieces of rubble were generally on the inshore (north) edge of each "mound"; offshore the substrate was predominantly sandy. Maximum vertical relief of the caisson rubble mounds, as measured by diver's depth gauges, was close to that described in Padre Associates, 1999. Rubble mound height of each caisson site was:

- Whitten West: 7 feet
- Whitten East 4 feet
- Needham 4 feet
- Ferguson 2 feet

References

L.A. de Wit, Consultant, 1998. *Marine Habitats and Biological Resources in the Area of Proposed Barge Anchoring Offshore Ventura County, California*. Prepared for Padre Associates, July 8, 1998. Job Number 98-005.

Padre Associates, Inc., 1999. *Final Mobil Seacliff Pier Complex Debris Survey and Removal Report*. Prepared for Mobil Exploration and Producing U.S., Inc. and Rincon Island Limited Partnership, July 9, 1999. Project Number 9702-0102.

The concrete rubble was easily detected from the natural substrate as it differed in color (gray) and texture (sharp angles) from the predominantly brown sediments, sediment-covered natural rock substrate.

Epibiota and Fish Communities

A total of 46 taxa of marine algae, invertebrates, and fish were identified from diver-biologists' notes and from the underwater photographs and videos. A list of those taxa is provided at the end of this report. The following discusses the dominant taxa observed at each site.

Low-relief Control Site: The algal community was dominated by under-story Rhodophyta (red algae) including *Acrosorium venulosum*, most abundant and *Rhodymenia*. Kelp, *Macrocystis* sp., was present but not abundant comprising a single holdfast with approximately 20 stipes. The encrusting coralline complex *Lithothamnion/Lithophyllum* was also present. Common invertebrate taxa included purple and red urchins (*Strongylocentrotus purpuratus* and *S. fransicanus*), the solitary stalked tunicate *Styela montereyensis*, and a lobate encrusting colonial tunicate, *Cystodytes lobatus*. Sea stars, including *Pisaster ochraceus* and *P. giganteus* were present, but not common within this habitat. Few fish were observed; juvenile olive rockfish, *Sebastes serranoides* were the most common.

High-relief Control Site: In contrast to the low-relief natural substrate, kelp was abundant at this site and under-story algae was less common, particularly under the kelp canopy. Where kelp did not exist, under-story algae (*Acrosorium* and *Rhodymenia*) was common; urchins grazing in one area near the top of the feature had removed macrophytic algae, exposing, the encrusting coralline *Lithothamnion/Lithophyllum* complex. Common invertebrate taxa associated with the high-relief control site included the chestnut cowry *Cypraea spadicea*, a tube-building polychaete *Salmacina tribranchiata*, and red urchins. Gorgonian corals, *Muricea californica,* were present along the sides of some of the reef-like ledges. Fish were also more abundant than at the low-relief natural substrate site. Species observed included kelp bass, *Paralabrax clathratus*, white surf perch (*Phanerodon furcatus*), pile perch, *Damalichthys vacca* and juvenile brown rockfish, *Sebastes auriculatus*.

Near the Whitten East and Needham sites, some high-relief rock was observed adjacent to the rubble mounds. Characteristic macroepibiota on those features included a gorgonian coral, *M. californica* and an unidentified colonial tunicate. Kelp and under-story red algae, including *Gigartina californica,* were present but not as abundant as on rock ridges at the high-relief control site.

Caisson Sites:

Flora: Although variable in abundance, kelp was observed at all four of the caisson sites. Kelp was most abundant at the higher relief Whitten West and East locations. At the two Whitten sites, kelp reached the surface and formed a canopy of approximately 20 feet in diameter at a +4.0 foot tide level. Kelp plants at the Needham and Ferguson caisson sites were smaller and had not yet reached the surface. Recruit- (two to 10 inches high) to adult-size kelp plants and were observed at all four sites, with many of the smaller plants anchored to pebble- or cobble-sized rubble. The holdfasts on the sub-adult and adult plants had in some cases, penetrated the rubble and sediment substrate and adhered to multiple pieces of concrete effectively holding the larger plants in-place. Some of the smaller plants were attached to a single piece of rubble and were floating in the water. Under-story algae, comprising most of the species noted as common at the low-relief control site, was abundant around the perimeter of each site and where the kelp canopy did not shade the rubble. That algal community was widespread at the Needham and Ferguson sites covering approximately 50% of the rubble there. Another brown alga, *Desmarestia ligulata*, was present around the perimeter of the Whitten sites and throughout the Needham and Ferguson sites.

Fauna: The macroepifauna at the caisson sites was relatively depauperate, consisting of three sea stars, *Pisaster ochraceus, P. giganteus,* and the less common *P. brevispinus*, the solitary tunicate *S. montereyensis* (locally abundant at Whitten West), a sea cucumber, *Parastichopus parvimensis*., and an occasional specimen of the large key-hole limpet, *Megathura crenulata.* Although not common, urchins and spiny lobster, *Panulirus interruptus* were occasionally observed at the Whitten sites, but were not found at the other two caisson sites. Ectoprocts and hydroids covered some of the larger rubble pieces, however the pebble- and cobble-sized rubble was relatively clean indicating that they are likely tumbled by waves and currents.

Despite the relatively depauperate macroinvertebrate community, the ichthyofauna was quite diverse at the Whitten sites and included aggregations of up to 25 white surf and pile perch, and individual kelp bass and juvenile olive rockfish, *Sebastes serranoides* in the water-column. Demersal species including barred sandbass, *Paralabrax nebulifer* and black surf perch, *Embiotoca jacksoni* were commonly observed at or near the bottom. Three California halibut, *Paralichthys californicus*, each estimated to be 24 to 30 inches long, were laying on the rubble at Whitten East, and a bat ray, *Myliobatus californicus* was observed on the sandy bottom immediately adjacent to the Needham rubble mound. Probably due to the relatively small amount of kelp, the fish community at Needham and Ferguson was less diverse and abundant than at the Whitten sites (see Appendix 1).

Comparison of Sites

Whitten West and East habitat and biota approximate those found at the high-relief control site, with the caisson sites having similar vertical relief and kelp abundance as the natural area. The caisson sites do not support the variety of epifauna found at the high-and low-relief control sites, however the macroalgal community at all six sites is similar. Of particular interest is the lack of urchins and the abundance the solitary tunicate *S. montereyensis* at the caisson sites. The rock ridges and larger boulders also support gorgonian corals, not found on the caisson rubble.

The diversity and abundance of the ichthyofauna appears to be directly related to the presence of kelp, with more fish found at both of the Whitten sites and at the high-relief control than sites where kelp was less abundant. Nine of the 10 fish taxa listed in Appendix 1 were observed at the caisson sites with the two Whitten sites supporting a relatively large number of perch compared to the natural substrate sites. Lobster were more abundant at the high-relief site than at any of the caisson sites.

The concrete rubble appears to provide suitable habitat for kelp and invertebrates not found on the predominantly low-relief rock and sedimentary substrates that surround most of the caisson sites. The caisson habitat is somewhat more uniform (*i.e.* fewer crevices and generally lower relief) substrate than the high-relief reef.

Compared to the 1998 survey, kelp and under-story algae have increased substantially throughout the area. The fish fauna, most of which is associated with the kelp habitat, was more diverse and abundant in 1999 than during the previous survey. During the most recent survey, there appeared to be less sediment on the rocky substrate (likely resulting in the increased algal abundance) than in July 1998, but the macroepifauna comprised many of the same species previously observed.

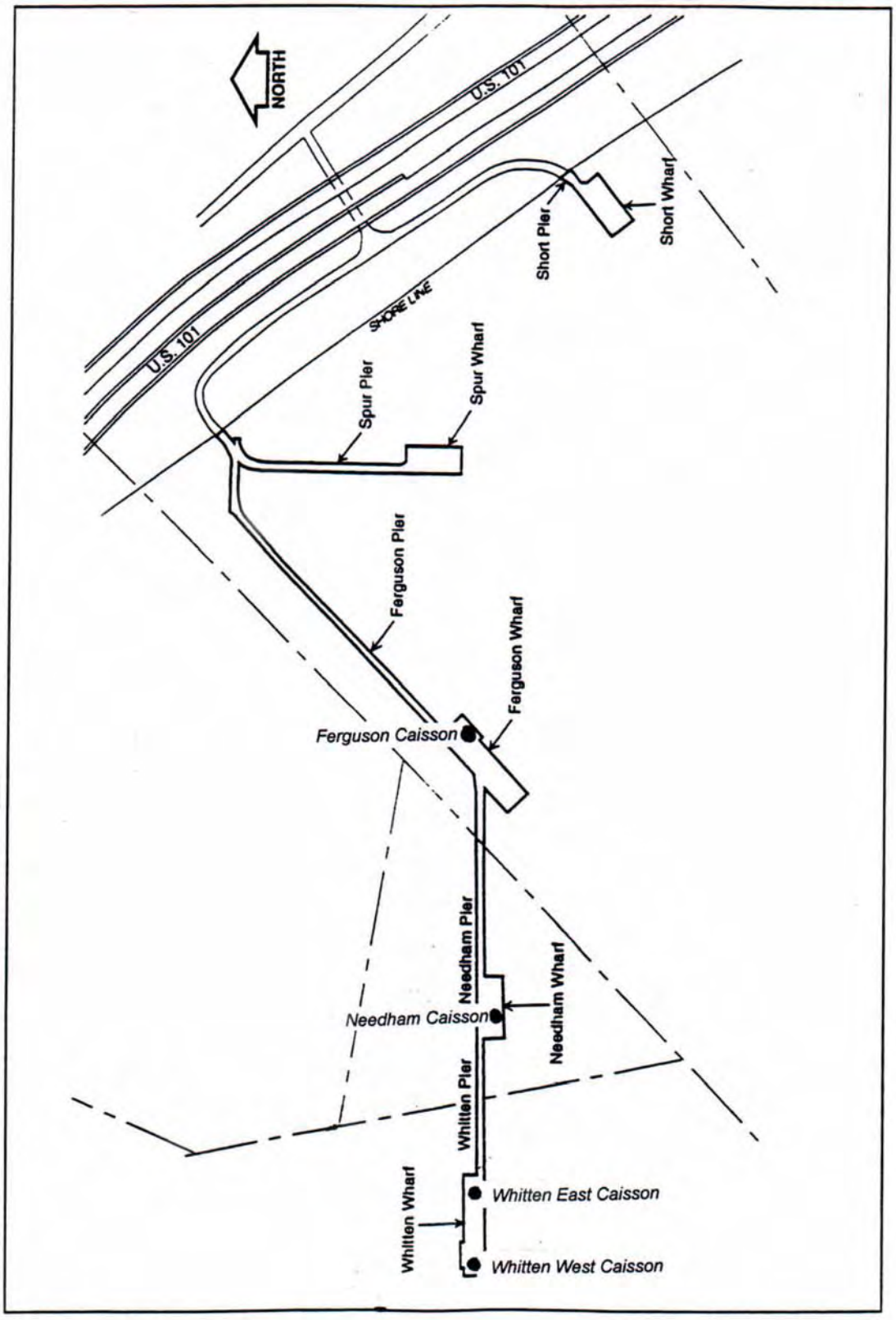
Normal offshore deposition of sediment (to the –20 to –25 ft isobath usually) during winter storms is expected to cover some of the rubble habitat and storm-wave activity is likely to remove kelp and other algae. Based on previous observations at the site, rubble and rock two to three feet above the existing seafloor would be expected to remain exposed during the winter season; low-relief areas will

be re-exposed when the sediment moves inshore during the spring/summer months. Therefore, while macroepibiota densities are likely to change, the concrete mounds are likely to continue to provide suitable habitat for kelp (and associated fish species), under-story algae, and an epifauna similar to that found at the high-relief control site within two to five years. One exception to that anticipated similarity could be a relatively low abundance of boring clams at the rubble sites. The shale ridges that comprise the natural reefs are susceptible to borers; the concrete is expected to be less so.

Summary of Findings

The habitat created by the concrete rubble supports a variety of marine flora and fauna, similar to that found on the surrounding natural rock substrate. Kelp is particularly abundant on the rubble mounds at Whitten West and East, but is present at all of the sites. The epibiota community associated with the concrete rubble mounds could be expected to become more diverse with time and should reflect a similar community as that found at the high-relief natural rock habitats within two to five years. Specific findings of the study are:

- The surveyed habitats comprise sediment, low- and high-relief natural rock substrate, and low- and high-relief concrete rubble mounds.
- Maximum vertical relief of seven feet above the natural seafloor was found at the high-relief natural rock control area and at the Whitten West and Whitten East caisson sites. Rubble at the two Whitten sites was generally larger than at Needham and Ferguson. Water depths of the survey area ranged from 19 to 24 feet., MLLW.
- Kelp was abundant on the high-relief natural rock substrate and on the upper four to seven feet of the rubble mounds at Whitten West and Whitten East. Probably due to scour across the relatively low-relief rubble mounds, kelp was present but less abundant at the Needham and Ferguson sites. Kelp was also uncommon at the low-relief natural rock site.
- Understory algae, comprising a variety of rhodophytes (red algae) was common where the kelp canopy was reduced or where urchins were not present.
- The macroepibiota at the two Whitten sites was similar to that at the high-relief control site and comprises at least 21 taxa. Kelp is abundant at both of these sites where it forms a surface canopy of at least 20 feet in diameter. Kelp at the Needham and Ferguson sites had not yet reached the surface.
- The fish community at the caisson sites was relatively diverse and had more individuals than a similar-sized area at the high-relief control site. Nine of total of 10 fish taxa observed at the six surveyed sites were present at the caisson sites. Surf perch were particularly abundant and two commercially important taxa (kelp bass and California halibut) were found at the Whitten sites.
- Although burial and exposure of the low-relief rubble areas will vary with season, the upper portions of the concrete mounds is expected to be exposed throughout the year and will likely support a epibiota similar to that at the high-relief control site within two to five years.



Source: Padre Associates, 1999.

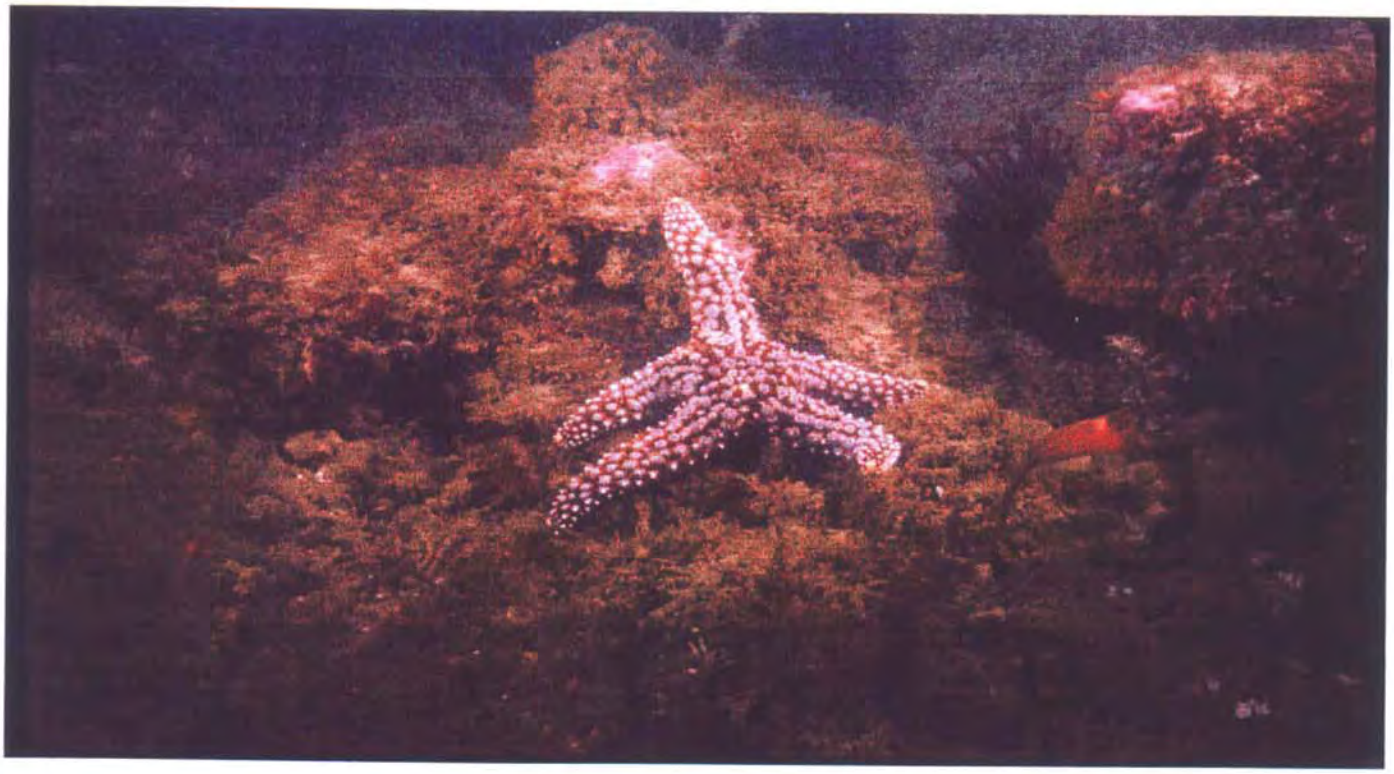
Figure 1
Original Configuration of Seacliff Pier Complex and Locations of Caisson Survey Dive Sites

Relative Abundance of Macroepibiota Observed During 8,9 September 1999 Dive Survey Seacliff Pier Demolished Caissons and Control Areas							
Species	**Survey Sites[1]**						**Notes**
	Whitten West	Whitten East	Needham	Ferguson	Low-relief Control	High-relief Control	
Algae							
Acrosorum venulosum.	p[2]	p	u-p	p-c	c-a	c-a	Most abundant on natural rock.
Desmarestia ligulata	loc. c	p	p	p- loc. c	p		Most common on low-relief inshore rock/rubble.
Gigartina californica	p			p	p	p	Present only on natural rock.
G. canaliculata			p		p	p	Present on natural rockonly.
c.f. *Iridophycus* sp.	p						
Lithothamnion/Lithophyllum					p	c	Present where understory algae had been removed by urchins.
Macrocystis sp.	c-a	p-a	p-c	p-c	u	a	Adults abundant on highest portions of rubble mounds and natural rock substrate. Juveniles and recruits on small and larger rubble pieces and natural rock. Only one holdfast at low-relief control site.
cf *Rhodymenia* sp.					c-a	c-a	Attached to natural rock only.
Ulva spp.			p	p			Attached to natural rock only.
Unid. filamentous red algae	p	p	p-c	p		c-a	Most common larger rubble where kelp was not present and throughout exposed natural rock habitat.
Cnidaria							**Hyrdroids, Anemones, Corals.**
Anthopleura elegantissima					p	p	Present around bases of natural rock.
Muricea californica		p				p	Present only on natural rock.
Unid. hydroids	p	p	p	p	p	p	
Annelida							**Worms**
Phragmatopoma californica				loc. a			Remnant tubes on low-relief rocks around Fergusson caisson site.
Salmacina tribranchiata						p-c	
Mollusca							**Snails, Clams, and Nudibranchs**
Cypraea spadicea			p			c	
Flabellonopsis iodinea						p	
Kelletia kelleti		u				p	
Megathura crenulata		u	u			p-c	
Mitra idea					u		
Echinodermata							**Urchins, Sea Stars, and Cucumbers**
Asterina miniata						p	
Parastichopus parvimensis	p	p	p	p		p	
Pisaster brevispinus	p	p	u	p			
P. giganteus	p	p	u		p	p	
P. ochraceus	p	p	loc. a	p	p	p	
Strongylocentrotus franciscanus	u	p			c-a	c-a	
S. purpuratus					loc c	c	
Unid. ophiuroid					u		

Relative Abundance of Macroepibiota Observed During 8,9 September 1999 Dive Survey
Seacliff Pier Demolished Caissons and Control Areas (Con't)

Species	Survey Sites[1]						Notes
	Whitten West	Whitten East	Needham	Ferguson	Low-relief Control	High-relief Control	
Arthropoda							**Crabs, Lobster, Barnacles**
Cancer productus			p	loc. a			Aggregation of approximately 20 on small rubble at Ferguson caisson site.
Loxothynchus crispatus		u					
L. grandis	p						
Panulirus interuptus	p	p				p	
Urochordata							**Tunicates**
c.f. *Chelosoma* sp.	p-loc. a	p					Most abundant on smaller rubble pieces.
Cystodytes lobatus	p	p	p		p	p	Present only on natural rock features.
Styela montereyensis	c-loc. a			p	p	c	Abundant on rubble and edges of rock.
Pisces							**Fish**
Damalichthys vacca	p-c	p				p	
Embiotoca jacksoni	c-a	p					Most common around kelp areas.
Myliobatis californica			u				One adult individual observed along edge of rubble.
Oxylebius pictus						p	
Paralicthys californicus		p					Three adult individuals on rubble mound.
Parlabrax clathratus	p		u			p	
P. nebulifer	p-c	p	u	u	p		Most common around edge of rubble mounds.
Phanerodon furcatus	a		u			p	Aggregations observed in kelp canopy (Whitten West).
Sebastes auriculatus (juveniles)						p	
S. serranoides (juveniles)	p				p		Three individuals in lower portions of kelp canopy.
Unid. juvenile rockfish			p				

[1] See Figure 1 and Table 1 for site locations.
[2] Relative Abundance: U=Uncommon, P=Present, C=Common, A=Abundant.

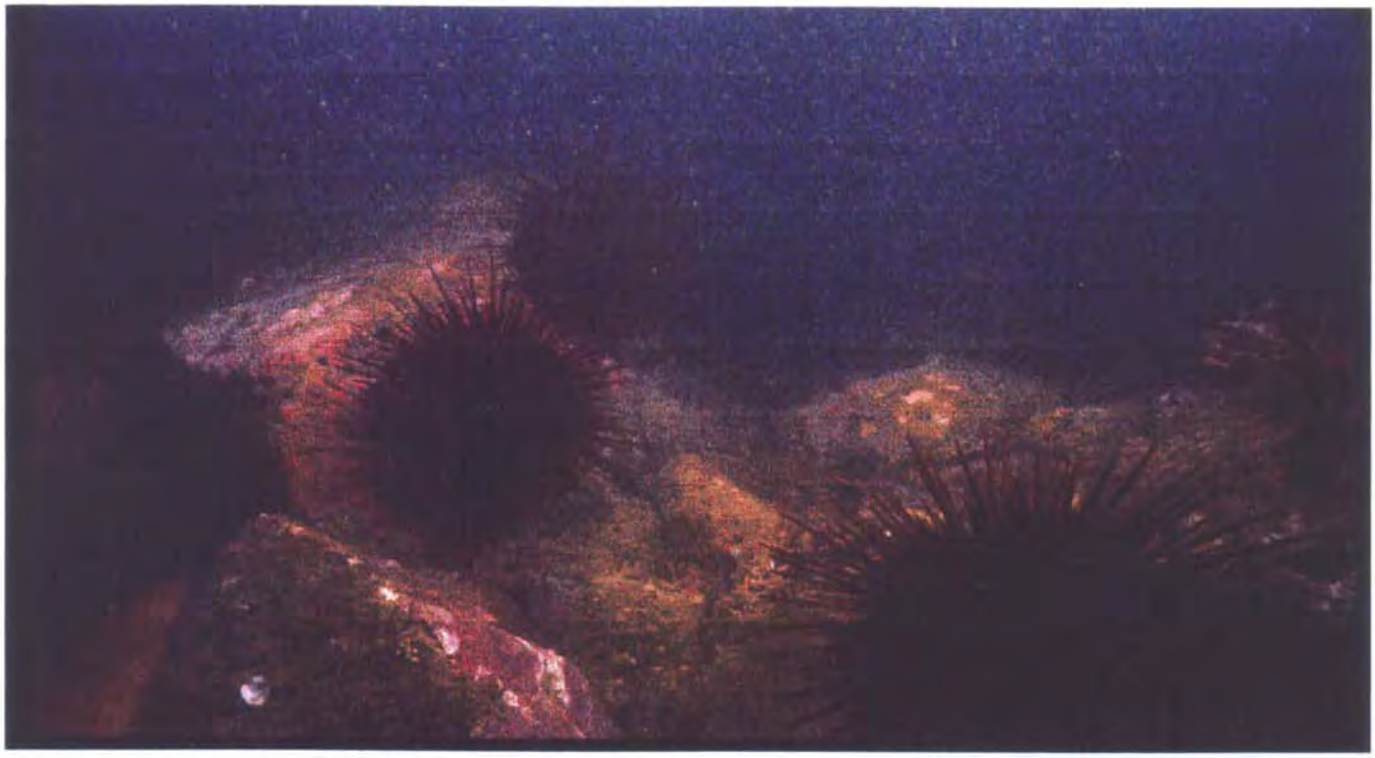


Sea star, *Pisaster giganteus*, stalked tunicate, *Styela montereyensis*, and urchin, *Strongylocentrotus franciscanus*

Pisaster giganteus and Chestnut cowry, *Cypraea spadicea* on pholad clam-bored reef rock

Plate 1
High-Relief Habitat and Biota

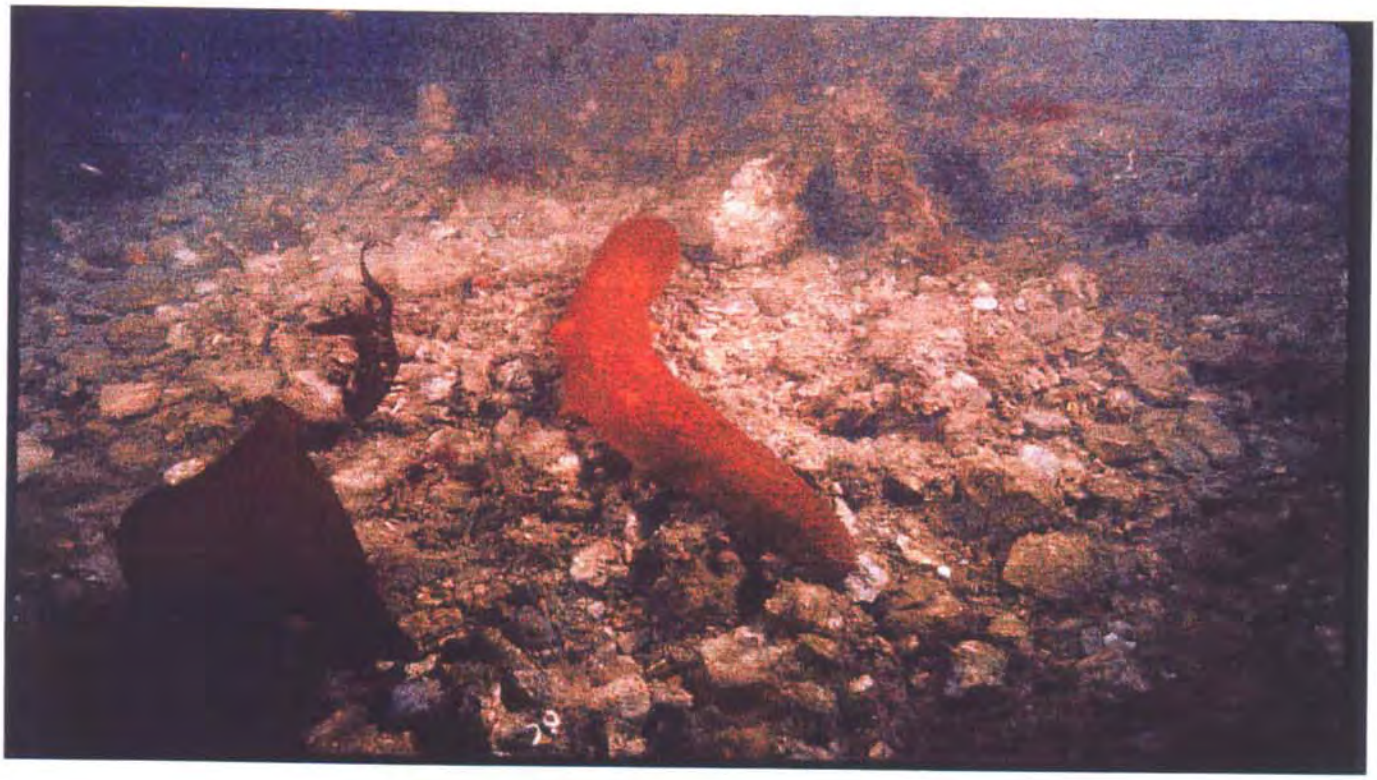
Sea cucumber, *Parastichopus parvimensis*, and stalked tunicate, *Styela montereyensis*, on algae-covered reef rock



Urchin-affected portion of reef with exposed encrusting coralline complex, *Lithothamnion*/*Lithophyllum*

Plate 2
High-Relief Habitat and Biota

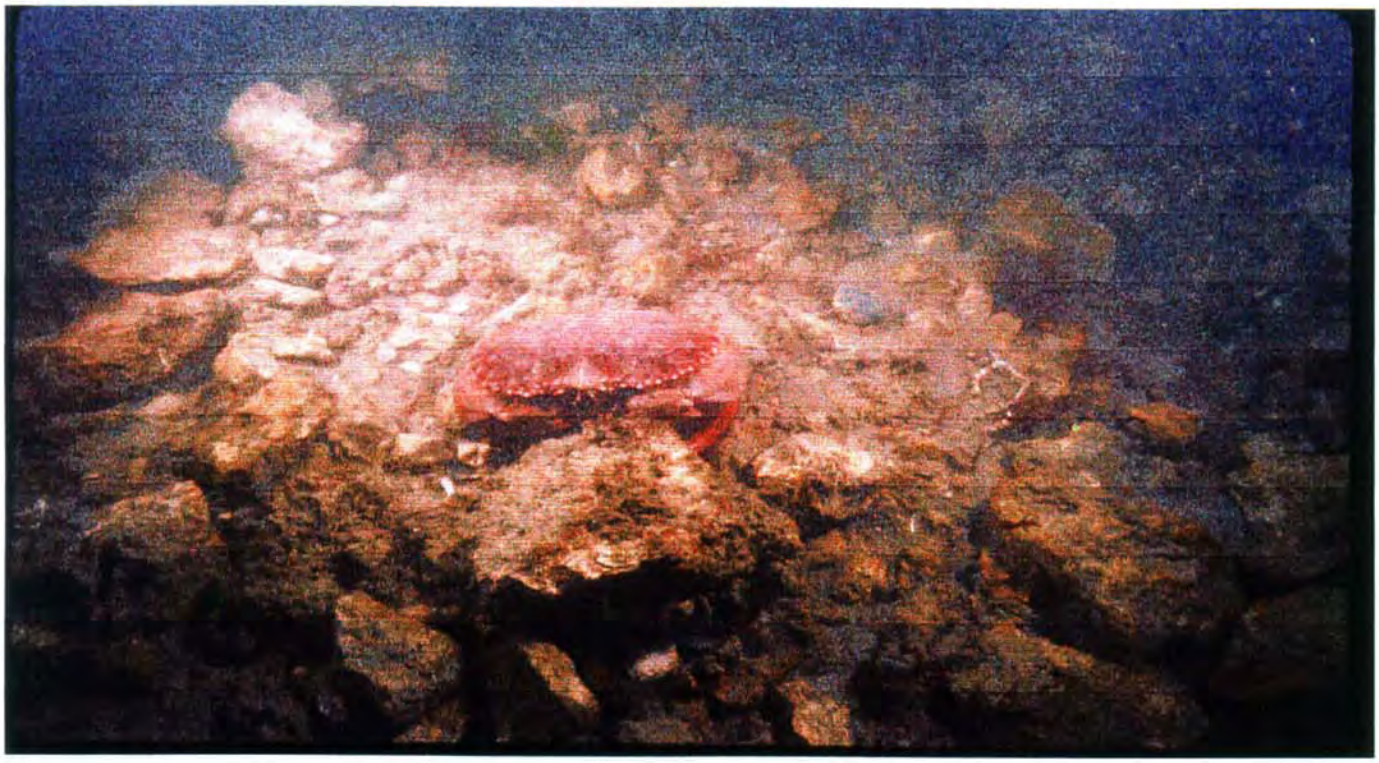
Sea star, *Pisaster ochraceus*, juvenile kelp, *Macrocystis* sp., and stalked tunicate, *Styela montereyensis*, at Whitten West caisson site



Sea cucumber, *Parastichopus parvimensis*, and under-story red algae at Whitten East caisson site

Plate 3
Concrete Rubble Habitat and Biota

Recruit-size kelp, *Macrocystis* sp. attached to concrete rubble at Ferguson caisson site



Rock crab, *Cancer productus*, at Ferguson caisson site

Plate 4
Concrete Rubble Habitat and Biota